

Field of the Invention TECHNICAL FIELD

Description of the Relevant Art~~BACKGROUND ARTS~~

Strikethrough Sheet

5 a voltage value by a current-voltage converter, A/D converting the voltage value
 by an A/D converter, and judging whether the short has occurred or not.
Judging whether the short has occurred or not is performed by: summing up the
A/D converted values only for the predetermined period by an integrate circuit,
 comparing the sum with the predetermined reference value, and outputting the
 10 signal indicating the occurrence of a short when the sum exceeds the reference
 value.

As a second conventional method for detecting the occurrence of a short in
 an electric circuit, ~~it is known that~~ by detecting a current value at every unit time
 15 and judging whether the short has occurred or not on the ~~base~~ basis of the
 variation of the absolute value of the current value. In this method, for example,
 when the second current value is smaller than the first current value and the third
 current value is bigger than the second current value, the signal indicating the
 occurrence of a short is ~~outputted~~ produced.

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However, according to the first conventional method, as only the current
 values ~~only~~ for the predetermined period are summed up, it is ~~needed~~ necessary to
 set the reference value smaller than the summed value to detect ~~the~~ a relatively
 small short current such as in case of tracking short. In case of a general short of
 25 two wires getting in touch with each other, the short current flowing between two
 wires is over several hundreds ~~Ampere~~ Ampere. In the contrary, in case of a
 tracking short, the short current is several ~~Ampere~~ Ampere ~~~to~~ about several
 scores ~~Ampere~~ Ampere. Therefore, in this conventional method, the reference
 value has to be below several ~~Ampere~~ Ampere to about ~~~~~ several scores
 30 ~~Ampere~~ Ampere to detect the tracking short. However, occasionally several
~~Ampere~~ Ampere ~~~to~~ about several scores ~~Ampere~~ Ampere of sudden over-current
 could flow in ~~the~~ an electric appliance like an incandescent lamp, ~~and it~~ It is
 difficult to distinguish such a sudden over-current from an electric appliance from
 the tracking short current. For example, in ~~the~~ an incandescent lamp of 20

5 ~~Ampere~~Ampere rated current, the sudden over-current could be up to 200
~~Ampere~~Ampere in maximum.

10 Further, according to the second conventional method, in the case of using
several household electric ~~appliance~~appliances simultaneously, the variation of
current value of each appliance is mixed up~~-. When the variation of current value~~
is mixed and occasionally it could show the same amount of variation that appears
in a tracking short. Therefore, it is still difficult to detect the tracking short
without error ~~by distinguishing from~~ the current caused by the use of several
household electric ~~appliance~~appliances ~~from the tracking short current.~~

15 As ~~diseribed~~described above, according to the conventional methods, it is
very difficult to detect ~~the~~ a tracking short without error. It is because the current
caused by a tracking short is almost the same ~~with~~ as the current caused by the
normal use of electric appliances.

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5 SUMMARY OF THE INVENTION ~~DISCLOSURE OF THE INVENTION~~

It is an object of the invention to provide a method for detecting tracking short without error by distinguishing the tracking short current from the current caused by the normal use of electric appliances or electric devices.

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The ~~inventors performed the followed~~ following comparison test was performed. The test ~~is~~ was for comparing frequency distribution of current variation caused by a tracking short in ~~the a~~ plug with that of a current variation caused by the normal use of several kinds of household electric appliances.

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~~The above~~ A predetermined period ~~is of~~ time was set at about 0.2 sec., ~~the above~~ A unit of time is was obtained by dividing the predetermined period ~~by~~ into 7 parts, and ~~the a~~ above current value obtained at every unit time is the absolute value of the peak value of current in the unit time.

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Whenever obtaining the current value, ~~we it was~~ compared it with a current value obtained at previous unit time and ~~wrote down the~~ difference between them recorded as the variation for each unit time. By repetition of the above process, ~~we got a~~ frequency distribution of variation was determined, and
 25 The frequency distribution of variation was then compared to the case of a tracking short with the case of the normal use of household electric appliances.

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A ~~We made~~ tracking short was intentionally formed by carbonizing the insulator between tracking electrodes in advance and supplying a AC(100V) power ~~to there~~. Then, ~~we observed the~~ waveform of current right after the occurrence of the tracking short was observed.

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In addition, ~~we observed the~~ waveform of the current was observed when the power was turned on with the rated voltage of several kinds of household electric appliance.

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As a result, ~~we got~~ Fig. 2 and Fig. 6 resulted from the experiments that showing the frequency distribution of current variation. In Fig. 2 and Fig. 6, the vertical axis indicates the variation (~~Ampere~~Ampere) at each unit time, and the horizontal axis indicates the rate (%) of the summed value of frequencies in each variation range over the total sum of frequencies in the predetermined period.

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Fig. 2 shows the frequency distribution of current variation in case of the occurrence of a tracking short, ~~and~~ Fig. 6 shows the frequency distribution of current variation for the appliance showing the biggest variation among the several kinds of household electric appliance.

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In comparison of Fig. 2 with Fig. 6, Fig. 2 shows that the variation is mostly concentrated in the range of 0~4 ~~Ampere~~Ampere, and Fig. 6 shows that although it generally spreads broadly, the variation in the range of 5~30 ~~Ampere~~Ampere is a little more than that in other ranges.

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The method described herein ~~present invention~~ is achieved on the base basis of the result of the above test for the purpose of detecting a tracking short. ~~And, it~~ The described method takes advantage of the fact that the frequency distribution of the current variation in the tracking short shows a characteristic feature.

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~~The inventors of the present invention achieved the following invention on the base of the above test.~~

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~~According to claim 1, the present invention is provided with~~ In an embodiment, a method for detecting tracking short with the current value on the electric circuit ~~comprising the steps of~~ may include: measuring the current value during the predetermined period to obtain the frequency distribution of the absolute value of current variation; comparing the rate of the frequencies in a

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5 predetermined range over the total frequency with reference value; and judging a tracking short to have occurred when said rate is above the reference value.

~~The invention according to claim 1 is~~ In some embodiments, a method may be applied to detect the occurrence of a tracking short, ~~and~~ The method may further makes it possible to detect ~~it the tracking short~~ without error by the new method taking advantage of the frequency distribution of current variation as a judgement ~~judgment~~ condition.

~~According to claim 2, the present invention is~~ In certain embodiments, a method may be provided with a method for detecting a tracking short with the current value on an electric circuit, ~~comprising the steps of~~ The method may include measuring the absolute current value at each unit time to obtain the current waveform. ~~The current waveform may be use for judging the occurrence of the tracking short. which is used for judgement wherein~~ The unit time is what is may be obtained by dividing the a predetermined period into several, ~~and~~ The method may include calculating the variation of the current value at each unit time by getting the difference between the absolute current value at each unit time and the absolute current value that at right of the previous or next unit time, ~~and~~ The method may include judging a tracking short to have occurred when the frequency in the predetermined variation range for the predetermined period satisfies the pre-set reference.

~~The invention according to claim 2 provides more specific configuration of the invention according to claim 1.~~

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~~According to claim 3, the present invention is provided with a method for detecting tracking short according to claim 2 wherein~~ In certain embodiments there may exists a plurality of variation ranges, and said a reference of frequency is set for the each of said plurality of ranges, ~~wherein the~~ The said

5 ~~judgement~~judgment step is ~~may~~ configured to judge the occurrence of a tracking short when each frequency in all the ranges satisfies the corresponding reference.

10 The invention according to claim 3 is another specific configuration of the invention according to claim 2 for more accurate judgement with more judgement conditions.

15 In some embodiments, ~~According to claim 4, the present invention is provided with a method for detecting a tracking short according to claim 2 or 3 may include performing a wherein said judgement~~judgment is performed at every unit time during the predetermined period.

20 ~~The invention according to claim 4 makes it possible to output a result as soon as the tracking short occurs by~~In other embodiments, the method may include: dividing the predetermined period into several unit times; performing the judgment step at every unit time; and outputting the result, at relatively small capacity by~~In addition, the method may include erasing an oldest datum of past predetermined period at every unit time.~~

25 ~~According to claim 5, the present invention is provided with a method for detecting tracking short according to claim 2, 3 or 4, further comprising the steps of~~In other embodiments, a method may include: dividing the unit time into several; obtaining the absolute value of the peak value of the current in every said divided time; and calculating the difference between each said obtained value and previous or next value of it, and. ~~The method may further include~~
30 ~~initializing and restarting said the judgement~~judgment step when the absolute value of the difference is below the predetermined reference value.

35 ~~The invention according to claim 5~~An advantage may be is providing more errorless method for detecting tracking short. More specifically, it is ~~may~~ be possible to protects the against error much far better by further dividing the

- 5 unit time into several parts and giving a corresponding ~~judgement~~judgment condition to each part~~,-~~. The reason being because it is often that the current variation exceeds the reference value only for pretty short time in case of tracking short.

5 BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of the invention will become apparent upon reading the following detailed description and upon reference to the accompanying drawings.

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Fig. 1 is a block diagram illustrating the configuration of the circuit according to the present invention.

Fig. 2 is a graph illustrating the exemplary frequency distribution of current variation in case the tracking short occurs.

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Fig. 3 is for explanation of the detecting method by the present invention according to claim 2.

Fig. 4 is for explanation of the detecting method by the present invention according to claim 4.

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Fig. 5 is for explanation of the detecting method by the present invention according to claim 5.

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Fig. 6 is a graph illustrating the exemplary frequency distribution of current variation in case of the household electric appliance.

While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof are shown by way of example in the drawing and will herein be described in detail. It should be understood, however, that the drawings and detailed description thereto are not intended to limit the invention to the particular form disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the present invention as defined by the appended claims.

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DETAILED DESCRIPTION OF THE INVENTION~~DESCRIPTION OF THE~~
PREFERRED EMBODIMENTS

10 A method for detecting a tracking short according to the present invention is characterized in detecting current in an electric circuit and judging the occurrence of a tracking short on the ~~base~~ basis of the variation of the detected current for ~~the~~ a predetermined time.

15 ~~This invention will be described in further detail by way of example with reference to the accompanying drawings.~~

Referring to Fig. 1, there is shown a block diagram showing the configuration of the circuit of one preferred embodiment in, ~~ease of applying the detecting method of the invention to~~ for example, a circuit breaker. As shown in 20 Fig. 1, the circuit breaker of the embodiment ~~is including~~ may include a current transformer 1, a ~~current-voltage~~ converter 2, a ~~rectifier~~ circuit 3 and a ~~judgement~~ judgment circuit 11.

25 ~~Said~~ eCurrent transformer 1 may detects current flowing in an ~~electric~~ circuit 10 and outputs AC current.

~~Said~~ eCurrent-voltage converter 2 may converts the AC current outputted from ~~said~~ current transformer 1 into the AC voltage, particularly through a resistor.

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~~Said~~ rRectifier circuit 2 may rectifies the output voltage from ~~said~~ current-voltage converter 2 using diodes etc. and outputs the absolute value of it. By using the absolute value, when an A/D converter ~~converter~~ digitalizing digitalizes the voltage, ~~the~~ a higher resolution can be obtained than ~~that in a case~~ 35 not using the absolute value.

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~~Said judgement~~Judgment circuit 11 ~~is configured~~may be adapted to always observe the output voltage from said-rectifier circuit 3. Judgment circuit 11 may further, judge whether the current is corresponding to a tracking short or not, ~~and, i~~. In case a tracking short occurs, judgment circuit 11 may output a cut-off command signal to the cut-off circuit so that a cut-off coil opens the contact of the circuit breaker.

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~~Said judgement~~Judgment circuit 11 ~~is comprising~~may include a microcomputer including ~~the~~-A/D converter 4, a-ALU 12, a-register circuit 13, and a-judgement output circuit 6.

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~~Said~~-A/D converter 4 may digitalizes the output voltage from said-rectifier circuit 3 by dividing the voltage into ~~the~~-a predetermined time width (sampling time). ~~of~~The predetermined time width may be the several milli second or below.

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For example, the sampling time can be about 0.25 ms.

For example, when the maximum input voltage of ~~the~~-A/D converter 4 is 5V, and the resolution of the digitalization is 8_bit, the output of ~~the~~-A/D converter 4 is 0 for 0V of input voltage, 127 for 2.5V, and 255 for 5V. ~~Here, if~~ By adjusting ~~the~~-current-voltage converter 2 so that the current of 1_bit is corresponding to 1A when A/D converting, it ~~is~~-may be possible to observe the current waveform of 0A~+255A with said-A/D converter 4. Further, as the means for digitalization, ~~said~~-ALU 12 equipped with ~~said~~-A/D converter 4 inside can be used.

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~~Said~~-ALU 12 may processes the current variation numerically on the ~~base~~ basis of A/D converted value by ~~said~~-A/D converter 4, and outputs the current variation data to ~~said~~-register circuit 13. Further, ~~ALU 12~~it may reads out the variation data stored in ~~said~~-register circuit 13, an may performs the ~~judgement~~judgment of the occurrence of a tracking short according to a built-in

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5 ~~program,~~ and ALU 12 may outputs the result signal to ~~said judgement~~judgment output circuit 6 in case the tracking short occurs.

Said ~~r~~Register circuit 13 ~~is always~~may retaining a plurality of current variations for the recent predetermined period in time ~~order~~ by erasing the oldest current variation while simultaneously writing in the latest current variation whenever the new current variation is transmitted from ~~said~~ ALU 12. It ~~is preferred that the~~ The number of the current variations always retained in ~~said~~ register circuit 13 ~~is~~ should be for example more than 7 for the improved accuracy of ~~judgement~~judgment. Also, The number of current variations retained It can be
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15 decided according to the capacity of the memory in the microprocessor and the length of ~~judgement~~judgment time.

In certain embodiments, ~~Said judgement~~judgment output circuit 6 may receives the ~~judgement~~judgment signal from ~~said~~ ALU 12 and outputs a signal to
20 ~~said a~~ cut-off circuit.

~~Said ALU 12 performs the following operations to carry out the method for detecting tracking short according to claim 1:~~

25 ~~Said~~ ALU 12 may extracts the peak value of current at every half-wavelength from the data of each sampling time transmitted from ~~said~~ A/D convertor 4. In addition, ALU 12 may compares it with the ~~right~~ previous peak value, and may transmits the difference of the two values ~~them~~ to ~~said~~ register circuit 13 as a current variation. Then, ~~Said r~~Register circuit 13 may stores the
30 current variation data of the predetermined period, ~~and,~~ when ~~When~~ receiving the new data from ~~said~~ ALU 12, register circuit 13 may erases the oldest data with while writing in the latest data. Herein, the predetermined period ~~is preferred to~~may be about 0.2 sec.

5 Said-ALU 12 may transmits the latest data to said-register circuit 13 and
 takes the current variation data from said-register circuit 13. ~~And then, it~~In
addition, ALU 12 may calculates the frequency distribution of the variation such
 as shown in Fig. 2 with the variation of the each data, and calculates the sum of
 frequencies in the predetermined variation range and the total frequency. After
 10 ~~that, it~~ALU 12 may also calculates the rate of the sum of frequencies in the
 predetermined variation range over the total frequency, and judges whether the
 rate is above the ~~judgement~~judgment reference or not.

Referring to Fig. 6, there is shown ~~aan~~ an exemplary frequency distribution
 15 of the current variation ~~in case of using when~~ household electric appliance are
used. It is shown that the frequency of variation is concentrated in the range of 0
 ~ 4 A. On the contrary, Fig. 2 is an exemplary frequency distribution of the
 current variation in case of a tracking short, and it is shown that the most
 frequency of variation ~~is existed~~exists in the range of 5 ~ 30A. Therefore, by way
 20 of calculating what percentage the frequencies in the variation range of 5 ~ 30A
 occupies ~~about~~ within the chosen range of the total frequency and judging
 whether it exceeds the ~~judgement~~judgment reference or not, it ~~is~~ may be possible
 to judge exactly whether the flowing current is caused by the use of household
 electric appliance or by a tracking short even though the magnitude of the flowing
 25 currents in both cases are almost same.

Said-ALU 12 ~~performs the following operations to carry out the method~~
~~for detecting tracking short according to claim 2.~~ Herein, the
~~judgements~~judgments by said-ALU 12 ~~is~~ may be performed on the ~~base~~ basis of
 30 the data for the predetermined period, ~~and, the~~ The predetermined period ~~is~~ may
be about 0.2 sec.

Fig. 3 ~~is for~~ depicts an explanation of unit time $A(i)$, detected current value
 $IPA(i)$ at each unit time, current variation $\Delta IPA(i)$, and a predetermined period
 35 ~~according to claim 2.~~ The predetermined period ~~is~~ may be divided into a plurality

5 of unit times $A(i)$ (here, $i=1\sim n$, n is a positive number). $IPA(i)$ ~~is~~ may be a current value that ~~said~~-ALU 12 extracts in the unit time $A(i)$ from the data transferred from ~~said~~-A/D convertor 4 in Fig. 1 at every sampling time. Although, in this embodiment, ~~said~~ $IPA(i)$ is a peak value in the unit time $A(i)$, it can be an average value in the unit time $A(i)$. $\Delta IPA(i)$ is a variation corresponding to the
 10 difference of a current value in the unit time and a current value in the right previous unit time. ~~Namely, it~~ can be expressed as the difference of $IPA(i)$ and $IPA(i-1)$.

Referring to Fig. 3, ~~said~~-register circuit 13 ~~is~~ may retaining n data of
 15 $\Delta IPA(1) \sim \Delta IPA(n)$ and a datum of $IPA(n)$. The initial status of ~~said~~ data ~~is~~ may be set zero.

Then, ~~said~~-A/D convertor 4 may transmits the data at each sampling time to ~~said~~ ALU 12. ~~Said~~-ALU 12 may extracts the peak value $IPA(n+1)$ of current in
 20 the unit time $A(n+1)$ ~~with~~ while simultaneously reading ~~out~~ the previous peak value $IPA(n)$ from ~~said~~-register circuit 13.

Then, ~~said~~-ALU 12 may calculates the $\Delta IPA(n+1)$ by the following equation:-

$$\Delta IPA(n+1) = IPA(n+1) - \Delta IPA(n).$$

25 ~~And then, it~~ In addition, ALU 12 may transmits the new value of $\Delta IPA(n+1)$ and $IPA(n+1)$ back to ~~said~~-register circuit 13, wherein if the $\Delta IPA(n+1)$ is negative, making it positive before transmission.

~~Said~~-Register circuit 13 ~~is~~ may be already retaining n data of $\Delta IPA(1)$
 30 $\sim \Delta IPA(n)$ and a datum of $IPA(n)$ as shown in Fig. 4 even before receiving the $\Delta IPA(n+1)$ from ~~said~~-ALU 12. Therefore, if receiving the new data of $\Delta IPA(n+1)$ and $IPA(n+1)$ from ~~said~~-ALU 12, ~~said~~-register circuit 13 erases the oldest data of $\Delta IPA(1)$ and $IPA(n)$ and shifts the value of $\Delta IPA(2)$ to $\Delta IPA(1)$, $\Delta IPA(3)$ to $\Delta IPA(2)$... $\Delta IPA(n+1)$ to $\Delta IPA(n)$ and $IPA(n+1)$ to $IPA(n)$. ~~At the same time,~~

5 ~~said~~ ALU 12 may also reads out the renewed n data of $\Delta IPA(1) \sim \Delta IPA(n)$ from
~~said~~ register circuit 13. In addition, ALU 12 may calculates the sum of the
number of data in the range of 5~30A of $\Delta IPA(i)$ as a frequency, ~~and.~~ ALU 12
may outputs the judgement ~~judgment~~ signal indicating the occurrence of a tracking
short to ~~said~~ the judgement ~~judgment~~ output circuit in case the frequency is more
10 than $n \times 0.7$.

~~According to above method of claim 2,~~ An advantage of this method may
be it makes it possible to judge whether the tracking short occurs or not with the
~~much more simpler judgement~~ judgment procedure of just comparing the sum of
15 data in the predetermined range with the reference. As opposed to method than
~~the method of claim 1 wherein the ALU 12 makes the frequency distribution and~~
calculates the rate.

~~According to claim 3,~~ In some embodiments, in addition to judgement
20 judgment condition about the number of data of which current variation is in the
range of 5 ~ 30A, having another condition that the number of data of which
current variation is in the range of 11——30A is above $n \times 0.4$, the
~~judgement~~ judgment that the tracking short has occurred is issued when the both of
conditions are satisfied. This make it possible to increase the accuracy of
25 distinguishment between the current due to a tracking short and the current due to
the use of household electric appliance.

~~Fig. 5 is for the explanation of judgement procedure according to claim 5.~~
In certain embodiments, Therein, the unit time $A(i)$ is further divided into m parts
30 $Ta(i,1) \sim Ta(i,m)$ (m is a positive number). In this embodiment, $Ta(i,j)$ is a
corresponding time to the half-wavelength of the frequency of commercial AC
power. As a cycle could be 50Hz or 60Hz according to the area, it ~~is~~ may be set
to a middle value, that is, about 9ms.

5 In Fig. 5, $IPT(i,j)$ is the peak value of the current in a divided time $Ta(i,j)$, and $\Delta IPT(i,j)$ is the value obtained by subtracting $IPT(i,j-1)$ from $IPT(i,j)$. Said ALU 12 ~~may receiving~~ receive the data from said A/D converter 4 at every sampling time and ~~may~~ extracts the peak value of current $IPT(i,j)$ in each divided time, and ~~ALU 12 may~~ calculates the $\Delta IPT(i,j)$ with the previous peak value
 10 $IPT(i,j-1)$ by the following equation.

$$\Delta IPT(i,j) = IPT(i,j) - IPT(i,j-1)$$

Herein, if the $\Delta IPT(i,j)$ is negative, it is converted to positive.

At the same time, ~~said~~ ALU 12 ~~may~~ calculates $\Delta IPT(i,j)$ for each divided
 15 time $Ta(i,1) \sim Ta(i,m)$. ~~And then, if~~ If the $\Delta IPT(i,j)$ is above the predetermined value (for example, it is set 5A in this embodiment), ~~said~~ ALU 12 proceeds to calculate the next $\Delta IPT(i,j)$. If the next $\Delta IPT(i,j)$ does not satisfy the predetermined value, ~~said~~ ALU 12 ~~may~~ initializes all the procedure ~~including the~~
~~procedure of claim 2 and 3~~ and begins the ~~judgement~~ judgment procedures again
 20 from the first stage.

More specifically, if all the values of $\Delta IPT(i,2) \sim \Delta IPT(i,m)$ in the unit time $A(i)$ are above the predetermined value, ~~said~~ ALU 12 continues the procedure of extracting the peak value of the current $\Delta IPT(i)$ in the unit time $A(i)$,
 25 ~~ALU 12 may obtaining~~ the current variation $\Delta IPT(i)$ by calculating the difference between $\Delta IPT(i)$ and $IPT(i-1)$, and transmitting it to ~~said~~ register circuit 13. However, otherwise, all the data in the register circuit 13 ~~are~~ may be initialized. Therefore, for ~~said~~ ALU 12 to judge that the flowing current is caused by a tracking short and output a signal to the ~~judgement~~ judgment output circuit 6
 30 in Fig. 6, it ~~is needed~~ may be necessary to satisfy two conditions at the same time. One condition ~~is~~ may be that all the values of $\Delta IPT(i,2) \sim \Delta IPT(i,m)$ illustrated in Fig. 5 are above the predetermined value and the procedure is being continued, and ~~t.~~ The other condition may be ~~is~~ that the current variation in each unit time $A(1) \sim A(n)$ satisfies the condition that when a frequency of the variation in a

5 predetermined range for the predetermined period satisfies a pre-set reference or in
claim 2 or 3 when each frequency in all the ranges satisfies the corresponding
reference. In a tracking short, most of the above $\Delta IPT(i,j)$ are can be sustained
 above the predetermined value, therefore, ~~according to claim 5, it is~~ may be
 possible to judge more exactly whether the current flowing on a circuit is caused
 10 by a tracking short or not without by a malfunction.

As described above, the present invention is described through the
 embodiments applying to the circuit breaker configured to breaks the circuit when
 detecting the occurrence of a tracking short. But, the present invention is not
 15 restricted to the circuit breaker, and it can be applied to outlets or it can be
 configured to alarm using a output signal of the judgement circuit 11.

Industrial applicability

~~As above, according to the present invention~~ According to the method and
 20 system described herein, by taking advantage of the current variation in
judgement judgment of the occurrence of a tracking short, it becomes possible to
 judge exactly whether a tracking short has occurred or not ~~in short time~~. It is also
possible to determine the occurrence of a tracking short even though the currents
 caused by a tracking short and by normal usage of electric devices are almost the
 25 same. In addition, it becomes possible to discriminate a tracking short without
 error by taking advantage of the characteristic current variation even though there
 occurs a load current or sudden overcurrent, or a plurality of household electric
 appliance are in use. Therefore, if the ~~present invention applied~~ method and/or
system described herein is applied to the a device connected to the power line for
 30 a home or a factory, it system/method can be used to assist I preventeding for a
tracking short to from cause causing a fire.

Strikethrough Version of Amended Claims

WHAT IS CLAIMED IS;

1. A method for detecting a tracking short using ~~a current value~~ in an electric circuit ~~comprises comprising the steps of;~~

measuring ~~the~~ a current value during ~~the~~ a predetermined period to obtain a frequency distribution of ~~the~~ an absolute value of ~~the~~ a variation of the current value;

comparing ~~the~~ a rate of the frequency in the predetermined variation range over ~~the~~ a total frequency with ~~the~~ a reference value;

and judging the tracking short to have occurred when ~~said~~ the rate is above ~~said~~ the reference value.

2. A method for detecting a tracking short using ~~a current value~~ in an electric circuit ~~comprises the steps of;~~

measuring ~~the~~ an absolute value of the current value at each unit time to obtain a current waveform which is used for judgment wherein the unit time is what is obtained by dividing ~~the~~ a predetermined period into several divided time units;

calculating ~~the~~ a variation of the current value at each unit time ~~by comprising~~ getting the difference between ~~the~~ an absolute value at each unit time and an absolute value at an adjacent that at right previous or next unit time,

and judging tracking short to have occurred when ~~the~~ a frequency of the variation in ~~the~~ a predetermined range for the predetermined period satisfies ~~the~~ a pre-set reference.

3. A method for detecting a tracking short according to claim 2,
wherein there exist a plurality of said variation ranges, and said reference of frequency is set respectively for each of said plurality of ranges,

and wherein the said step of judging is judging the tracking short to have occurred when each frequency in all the ranges satisfies the corresponding reference.

4. A method for detecting tracking short according to claim 2 ~~or 3~~, wherein ~~said~~ the judgement ~~judgment~~ is performed at every unit time for the predetermined period.

5. A method for detecting tracking short according to claim 2, ~~3 or 4~~, further comprising dividing the unit time into several divided time units, obtaining ~~the~~ an absolute value of a peak value of current in each said divided time unit, calculating ~~the~~ a difference between said value and the previous or next value of it, and initializing and restarting the said ~~judgement~~ judgment ~~step~~ when the absolute value of said difference is below the predetermined reference value.

ABSTRACT

The present invention relates to method for a detecting tracking short;
wherein In some embodiments, the method may include detecting current flowing
on an electric circuit; In other embodiments, the method may include calculating
10 the frequency distribution of the variation of the current detected in ~~the~~ a
predetermined period; and In an embodiment, the method may include
outputting ~~the~~ a detecting signal in case the frequency of variations included in
the predetermined range satisfies ~~the~~ a judgement reference.